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## **ABSTRACT**

Strategically Planning the Successful Delivery of Highly Technical Facilities

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Abstract: A discussion of the use of design/build construction for the successful delivery of the Strategic Computing Complex at the Los Alamos National Laboratory

# **Strategically Planning the Successful Delivery of Highly Technical Facilities**

**Mark S. Harris**

## **Background and Description of the Strategic Computing Complex**

Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico and is operated by the University of California (UC) for the U.S. Department of Energy (DOE). The primary mission of Los Alamos National Laboratory is to support the nuclear weapons program for the Department of Energy. There are over 10,000 personnel at Los Alamos employed by DOE, UC and various subcontractors.

The Strategic Computing Complex (SCC) supports the weapons program by computer simulation of weapon detonations, taking the place of underground testing banned by international treaty. The SCC is a 300,000 square foot, three story facility that will hold approximately 300 personnel that perform the simulations required to certify the U.S. weapons stockpile. The SCC is basically a support system for up to two large computers, weapons designers, physicists, and computer scientists. The heart of the facility is a 43,500 square foot computer room that is designed to hold computers that did not yet exist.

## **Strategic Planning Process**

The DOE approached UC employees at LANL on September 30, 1997, and asked LANL to design and build a computing complex, to be ready to accept the world's most powerful computer in January, 2002. The significant challenges UC LANL was asked to accept and overcome included:

1. Develop our project simultaneously with a similar project at Lawrence Livermore National Laboratory (LLNL), which already had developed a Conceptual Design Report and was 18 months ahead of us in the Congressional funding process. Only one of these projects would be fully funded.
2. Deliver a line item project in 4 1/2 years in the DOE system, which normally takes a 6-year cycle.
3. Deliver a building to support a computer that didn't exist yet, and by the way, make the building flexible enough to support future generations of computers that also didn't exist yet. The first generation of computer is capable of 30 Tera-flops (30 trillion floating point operations per second) with future generations capable of up to 100 Tera-flops.
4. Include enough simulation technology, data transmission and data storage capability in the building to support a computer that doesn't exist yet, and scientist who don't know what they need yet.

5. DOE set the total project budget and determined the yearly funding profile, with no input from LANL, before we even started the project. This severely impacted the ability to perform the project and deliver the building by the requested date.

The basic question that had to be answered was “How do you deliver a highly technical project with significant technical unknowns, within a self limiting process, that has a nearly impossible schedule and inadequate funding, and keep your customer happy?”

The UC LANL Project Team determined the best course for success included the following attributes:

1. A conventional design-bid-build project delivery method resulted in a best completion date of September 2002, which did not meet our DOE customer's requirements. That assumed no funding glitches and no delays of any kind. The delivery method was changed to design/build to shorten the overall schedule to meet a delivery date of January 2002. Design/build also places the total responsibility for design and construction in one place, forcing cooperation and communication between engineers and contractors.
2. A conceptual design was developed that incorporated the maximum amount of flexibility in the building and system design to account for the significant unknowns associated with the non-existent computer. Flexibility and expandability of building systems to support the computer were the basic design approach. Coordination with the Computer Procurement team was essential for success. Our conceptual design report was completed in six months, validated by DOE and was funded.
3. Partnering with the successful bidder was essential to ensure project delivery, solve potential technical or schedule issues, and to ensure a quality product. The contractor was able to provide additional innovative construction methods and materials, which resulted in additional schedule savings (3 months) and quality products.
4. The integrated project team and partnering approach allowed problems to be solved at the lowest possible level in the shortest possible time. Everyone benefited.
5. Performance specifications were developed which told the contractor what the final product must be capable of doing, but at the same time allowed the contractor enough flexibility in choosing quality products and construction methods that would support the overall project objectives.
6. The simulation, data transmission, and data storage technology required for this project is constantly changing. Constantly changing technical requirements do not support a fixed cost or tight schedule. The Project team decided to let the final end user supply and install the simulation and data storage equipment after project completion. The project supplied the infrastructure necessary to support the equipment. This approach allowed design and construction to continue while the scientists developed their approach with the latest available technology. Data transmission systems were over sized to allow for future expandability.
7. After developing the design with input from all appropriate sources, a hard line “no changes during construction” stance was taken with the users, with the support of UC LANL management. This approach minimized change orders and potential schedule

impacts. This approach requires discipline and cooperation between all team members, and forces you to excel in customer relations.

8. DOE cooperation on obtaining funding in the first few days of each fiscal year was essential to maintain the project schedule and avoid cash flow issues. DOE obtained early funding, in spite of an uncertain federal budget and in the face of continuing resolutions from Congress. At our request, DOE was even able to move \$6 million dollars in funding up one fiscal year, allowing the project to purchase some long lead time equipment early and improve the construction schedule.